3-5: Observing Earth's Seasonal Changes Lesson Plan

Purpose: In this lesson, Observing Earth's Seasonal Changes, students observe patterns of average snow and ice amounts as they change from one month to another, as well as connect the concepts of the tilt and orbit of the Earth (causing the changing of seasons) with monthly snow/ice data from January 2008 to June 2008.

Grade Level: 3-5 **Time:** 2-45 minute class periods **MND Lesson # 77**	**Lesson Objectives:** • The student will be able to use evidence to create an explanation. • The students will be able to construct a graph or model using scientific principles. • The students will be able to describe expected weather conditions for a particular season. • The students will be able to employ observations in order to explain a phenomenon.	**Sphere(s):** • Atmosphere • Hydrosphere

Phenomena NASA Connection:

Why is it that when the Earth is closest to the sun, the Northern Hemisphere has winter? And when they are farthest from the sun, they have summer? This phenomenon occurs because of Earth's tilt, which causes the seasons to occur and thus the climate of that region. Climate describes patterns of typical weather conditions over different time scales. NASA scientists use data from multiple satellites to analyze historical weather patterns to answer questions related to climate. GLOBE and MY NASA DATA enable educators and students to connect with NASA scientists and access the satellite data to answer their own questions related to atmospheric interactions that affect our weather and climate. In this lesson, Observing Earth's Seasonal Changes, students will observe patterns of average snow and ice amounts as they change from one month to another, as well as connect the concepts of the tilt and orbit of the Earth (causing the changing of seasons) with monthly snow/ice data from January 2008 to June 2008.

Essential Questions:

1. What types of weather conditions are associated with each of the different seasons?
2. How do the seasons differ between hemispheres?
3. What factors affect the type of climate found in a particular region of the world?

NGSS Performance Expectation(s):

- **3-ESS2-1** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
- **3-ESS2-2** Obtain and combine information to describe climates in different regions of the world.
- **4-PS3-2** Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- **4-PS3-1** Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
- **5-ESS2-1** Develop a model using an example to describe a scientific principle.

Science & Engineering Practices:	**Disciplinary Core Ideas**:	**Crosscutting Concepts**:
Analyzing and Interpreting Data: Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationship. **Developing and Using Models**: Develop a model using an example to describe a scientific principle. **Obtaining, Evaluating, and Communicating Information**: Obtain and combine information from books and other reliable media to explain phenomena.	**ESS2.D Weather and Climate**: Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.	**Patterns**: Patterns of change can be used to make predictions. Systems and System Models: A system can be described in terms of its components and their interactions.

NCTM Math Standards: n/a

Cross-Curricular Connections:
National Geography Standards:
-How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.

Career Connections:

- **Atmospheric and Space Scientists** – Investigate weather and climate related phenomena to prepare weather and climate related phenomena to prepare weather reports and forecasts for the public
- **Computer and Information Scientists** – Conduct research in the field of computer and information science
- **Cartographers and Photogrammetrists** – Collect, analyze, and interpret geographic data in creation of maps
- **Applications Software Developers** – Develop and modify computer applications software that are used to communicate with satellites and people using satellite data
  -Computer Programmers
  -Systems Engineers
  -Software Engineers

Multimedia Resources:

- Snow and Sea Ice on the Poles (0:36) https://youtu.be/P7HatiSMTRU
- Why Do We Have Seasons? Interactive - (https://www.pbslearningmedia.org/resource/npls13.sci.ess.seasons/why-seasons/#.WWjBqqI-JK6)
- Student Datasheet Teacher Key

Materials/Resources Needed:
Per Student:

- Scientists Monthly Mix-Up Datasheet
- Our Investigation! Student Datasheet

Per Group:

- Copy of Student Pages: January, March, and June 2008 Snow/Ice maps
- Copy of Student Pages: January, March, and June 2008 Monthly Leaf Area Index maps

Key Vocabulary:

- Season
- Observations
- Equator
- Latitude/Longitude
- Landmass
- Orbit
- Angle
- Claim
- Evidence
- Reason

Background Information:

Earth's surface is a complex and dynamic set of interconnected systems – principally the geosphere, hydrosphere, atmosphere, and biosphere. All of the Earth's processes are the result of energy flowing and matter cycling within and among these systems. Weather and climate are shaped by complex interactions involving sunlight, the ocean, the atmosphere, clouds, land, ice, and life forms.

The seasons are caused as the Earth, tilted on its axis, travels in its orbit around the Sun each year. The hemisphere that is tilted towards the Sun is warmer because sunlight radiates more directly to the Earth's surface. As a result, there is less scattering of the Sun's radiation in the atmosphere.

Prerequisite Student Knowledge:

- Seasonal changes in weather
- Names of continents
- Basic ability to read a map
- Cardinal directions
- Revolution and orbit (Earth travels around the sun)
- Weather patterns are not the same around the world
- Familiarity with Earth's systems and biomes

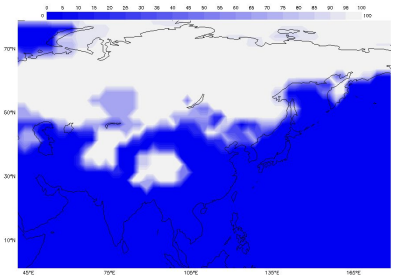
Possible Misconceptions:

- "Often students who believe that the seasons are caused by Earth's distance to the sun think that Earth orbits the sun in an elongated elliptical path and that this is what causes Earth's distance from the Sun to vary enough to cause the seasons In fact, Earth's orbit, while elliptical, is nearly a perfect circle."
- "Others may think that the sun is not in the center of Earth's orbit, thus causing Earth to be closer or farther away from the Sun at different times. While it's true that the Sun is at one focus of Earth's elliptical orbit, the fact that the orbit is nearly a perfect circle means that the distance from Earth to the Sun remains nearly constant all year."
- "Even people that know that Earth's tilt has something to do with the seasons might think that there is something about the tilt that causes Earth to be much closer to the Sun at certain times of the year. In fact, the tilt does not make any significant difference in the distance of Earth to the Sun."

-Taken from AAAS Science Links

Procedure:

Part 1: Honing Our Observation Skills



1. Distribute and review the Model Data Visualization of Snow/Ice Amount (percent) for November 1999, as well as the Student Datasheet: *Scientists Monthly Mix-Up Datasheet* as a class.
2. First, direct students' attention to the visualization's scale and gradient that appears on top of the image. Be sure to explain that the lighter the map gets, the more snow accumulated in that area during that month.
3. Ask students:
    a. What continent is featured in the visualization?
    b. What do you observe?
    c. How does this continent's climate compare to where you live?
    d. Which latitude shows the most amount of snow? Least? Which longitude shows the most amount of snow? least?
4. Walk students through the process of collecting at least three explanations of evidence for each map using qualitative and quantitative data, such features as latitude, longitude, percent coverage, etc.
5. Next have them create a "claim" that

Model Example	
Evidence: • Latitude 65°-70° have the most snow • Snow appears above 30°N • 90°E has most snow • Snow covers upper half of the map • Russia contains 90% of the snow	Claim: • November is a very cold month in Northern Asia that includes high levels of precipitation.

includes an explanation of this evidence in the Claim column.

Part 2: Using Observations to Solve the 'Data Mix-Up' Problem

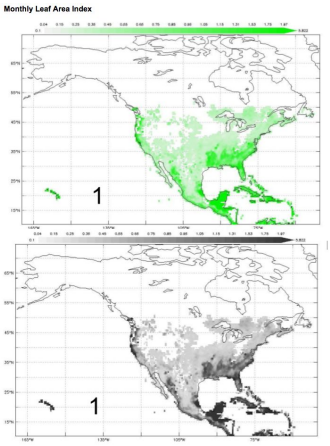
Read the scenario to the students:

Please Help! *A solar flare has interrupted satellite transmission and as a result, NASA scientists received partial information of snow and ice. NASA engineers and scientists had to turn off the instruments on the satellites before they could finish receiving all the data. We need your help to review these map visualizations to identify if sufficient data was received to identify which Snow and Ice Map visualizations represents the months of January, March, and June. You will use the snow and ice values on each map, your keen observation and inference skills, and knowledge about the seasons to solve this problem. The scientists need an explanation for each month so they have evidence of your claim".*

6. Break students into groups. Provide each group with three maps (January - #3, March #1, and June 2008 - #2) . Select *NOTE: Students should **not** know the months' names of the maps in order to set up the scenario. Be sure to print the Student Page of the Data Visualization, rather than the Teacher Page.*
7. To pique their observations skills, play the Snow and Sea Ice on the Poles. Clarify to the students that the data that they will receive was obtained using NASA satellite data. Using the Snow/Ice data as evidence, they will make claims as to the time of year the map represents.
8. Select #1 and #2 as a class to do a comparison.
   -Which one shows the higher amount of snow and ice? Explain.
   -What month can you infer is a warmer month? Why?
9. Students continue in their groups making observations and discussing what they notice about the visualizations. **NOTE**: If students become stuck, here are some questions to help guide them:
   a. Where is most of the snow/ice located? (At which latitude and longitude?)
   b. How far does the snow/ice extend? (Between which latitudes and longitudes).
   c. Looking at North America (*or applicable continent*), how do we figure out what month it is based on knowing the weather patterns where you live?
   d. What season is shown in each of these maps?
10. After students have completed the datasheet, students share out their group's explanations and explain the correct answers.
11. Using PBS's interactive visualization, 'Why Do We Have Seasons?,' review and describe the phenomenon of seasons. The teacher should look at each city's tab on the visualization (New York, US; Miami, US; Singapore; and Melbourne, Australia) and each of the three months (Early February, March, and June). Be sure to describe why the sunlight hits at different intensities, even though the Earth is in a mostly circular orbit. *Possible misconceptions should be addressed here.*
12. Distribute the Student Pages of the Monthly Leaf Area Index maps for January, March, and June 2008 and the *Our Investigation!* Student Datasheets to students.

Part 3: Exploring Related Datasets

1. Ask students to predict the meaning of the Monthly Leaf Area Index variable. Direct students to observe the darker greens (or grays) show where more tree canopy cover exists in that area and the lighter areas are where less canopy cover occurs. *(Tree Canopy Cover is the layer of tree leaves, branches, and stems that cover the ground when viewed from above.)* Be sure to acknowledge that areas that are shades of green (or gray if in grayscale) contain canopy cover.
2. Review the *Our Investigation!* Student Datasheet with students. Students now repeat the process of making observations, collecting evidence on their datasheet, and writing claims.
3. Once students have filled out the table, have them discuss in their groups and answer the questions on the bottom of their datasheet.



Student Datasheet

Name: _____
Date: _____

Scientists Monthly Mix-Up Datasheet

Scenario: ***Please Help!*** *A solar flare has interrupted satellite transmission and as a result, NASA scientists received partial information of snow and ice. NASA engineers and scientists had to turn off the instruments on the satellites before they could finish receiving all the data. We need your help to review these map visualizations to identify if sufficient data was received to identify which Snow and Ice Map visualizations represents the months of January, March, and June. You will use the snow and ice values on each map, your keen observation and inference skills, and knowledge about the seasons to solve this problem. The scientists need an explanation for each month so they have evidence of your claim".*

Observe the snow and ice amount on the maps. Complete the chart below. Under Evidence, write your observations. Include longitude and latitude of key locations and amounts of snow and ice. In the Claims section, match the maps with the months: January, March, or June.

Model Example	
Evidence:	Claim:

Map 1	Evidence:	Claim:
Map 2	Evidence:	Claim:
Map 3	Evidence:	Claim:

Student Datasheet

Name: _____
Date: _____

Our Investigation!

1. What is the Monthly Leaf Area Index?

Observe the Monthly Leaf Area Index on the maps. Complete the chart below. Under Evidence, write your observations. Include longitude and latitude of key locations and amounts of leaf area or canopy cover. In the Claims section, match the maps with the months: January, March, or June.

Map 1	Evidence:	Claim:
Map 2	Evidence:	Claim:
Map 3	Evidence:	Claim:

1. Compare and contrast the maps for snow/ice and leaf area. Explain what you noticed.

2. Based on your observations, predict other events that may help tell what season it is and explain.

TEACHER KEY

Scientists Monthly Mix-Up Datasheet

Please Help! NASA scientists have mixed up their satellite data and no longer know which Snow and Ice Map represents the months of January, March, and June. They need your help identifying the maps with their respective months. You will use the snow and ice values on each map, your keen observation and inference skills, and knowledge about the seasons to solve this problem. The scientists need an explanation for each month so they have evidence of your claim".

Observe the snow and ice amount on the maps. Complete the chart below. Under Evidence, write your observations. Include longitude and latitude of key locations and amounts of snow and ice. In the Claims section, match the maps with the months: January, March, or June.

Model Example	
Evidence: • Latitude 65°–70° have the most snow • Snow appears above 30°N • 90°E has most snow • Snow covers upper half of the map • Russia contains 90% of the snow	Claim: • November is a very cold month in Northern Asia that includes high levels of precipitation.

MAP 1	Evidence: • Half US is covered in snow/ice • Great lakes light blue • Less white than Map 2 and 3 • etc. *Answers will vary*	Claim: *This is March because . . . the snow/ice are cover more of the map than Image 3, but less of the map than Image 2.* *(might include comparison of maps and evidence from the observation box)*
MAP 2	Evidence: • US almost entirely blue • No snow covering Eastern or Western portions • Alaska has 50% less snow than Map 2 • etc. *Answers will vary*	Claim: This is June because . . . The map has the least amount of snow compared to the other two, meaning it is a warmer month. *(might include comparison of maps and evidence from the observation box)*
MAP 3	Evidence: • More snow cover than Map 1 • Snow creeps down western part of US • One big sheet • etc. *Answers will vary*	Claim: This is January because . . . snow/ice cover almost all of the map, meaning that it is much colder now. And in my state we have snow in January and so does this map. *(might include comparison of maps and evidence from the observation box)*

TEACHER KEY

Our Investigation! Datasheet

1. What do you know about Monthly Leaf Area Index?
   Monthly leaf area index shows us the amount of canopy cover or vegetation that is growing in an area. One the map, green indicates where this is occurring, the darker the green the more leaves are present.

Observe the Monthly Leaf Area Index on the maps. Complete the chart below. Under Evidence, write your observations. Include longitude and latitude of key locations and amounts of leaf area or canopy cover. In the Claims section, match the maps with the months: January, March, or June.

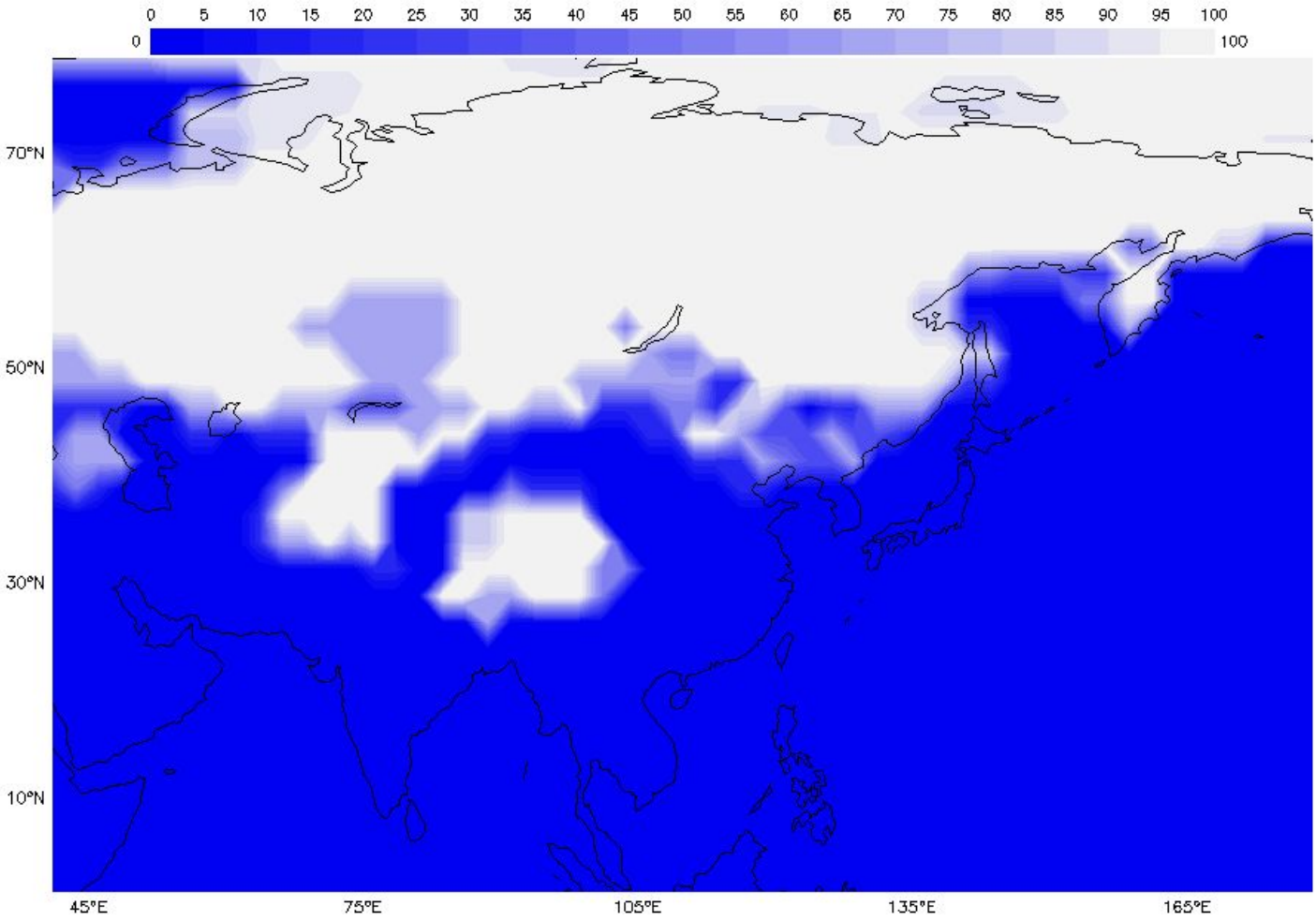
Map 1	Evidence: • There is more white shown, less leaves, than Maps 2 and 3 • Dark green appears in warmer regions, south • Map is half white • Etc.	Claim: This map shows January because there is a lot less leaf area than the other two maps, which typically means it is a colder month.
Map 2	Evidence: • Most of the map is covered in green, >85% • Contains more dark green, West, than Maps 1 and 3 • Canada covered too • Etc.	Claim: This map shows June, because the map is mostly covered in greens and lots of dark greens. This means it is a warmer month because it has more than both Maps 1 and 3.
Map 3	Evidence: • Alaska now has greenery • More green than Map 1 but less than Map 2 • About 60% of map is covered in green • Etc.	Claim: This map shows March because the amount of green/leaves is in between Map 1 and Map 2. The green has stretched farther up North and has less darker green than Map 2.

1. Compare and contrast the maps for snow/ice and leaf area. Explain what you noticed.
   Both maps appeared to show an increase or decrease in their amounts when the months were changing. Like, snow/ice amount decreased as the months got warmer, but leaf area increased as the months got warmer. So, both variables fluctuate with seasonal change. This could indicate that these are both receptors to temperature or amount of sunlight.

2. Based on your observations, predict other events that may help tell what season it is and explain.
   Other events could be precipitation, maybe in the warmer months more precipitation occurs. Another, is temperature because we know it gets colder in the winter and warmer in the summer.

Snow/Ice Amount (percent) November 1999 **MODEL EXAMPLE**

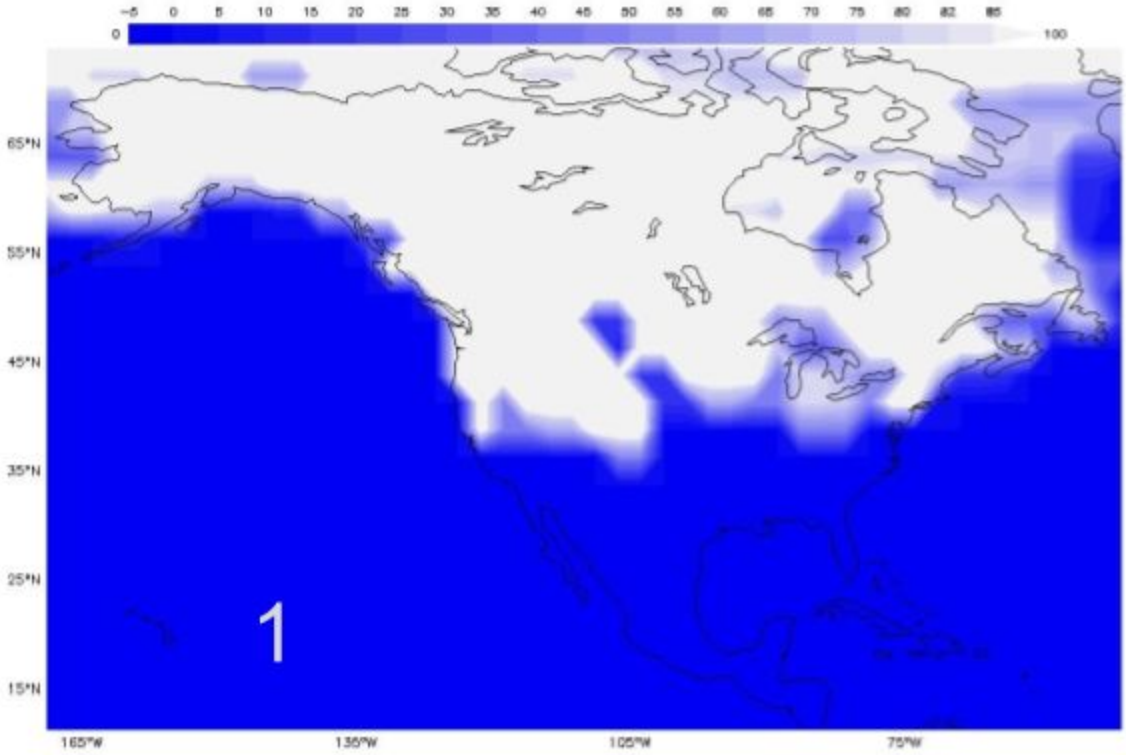
Asia


0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
0
100
70°N
50°N
30°N
10°N
45°E
75°E
105°E
135°E
165°E

Data Visualization

STUDENT COPY

Snow/Ice Amount (percent)



Data Visualization

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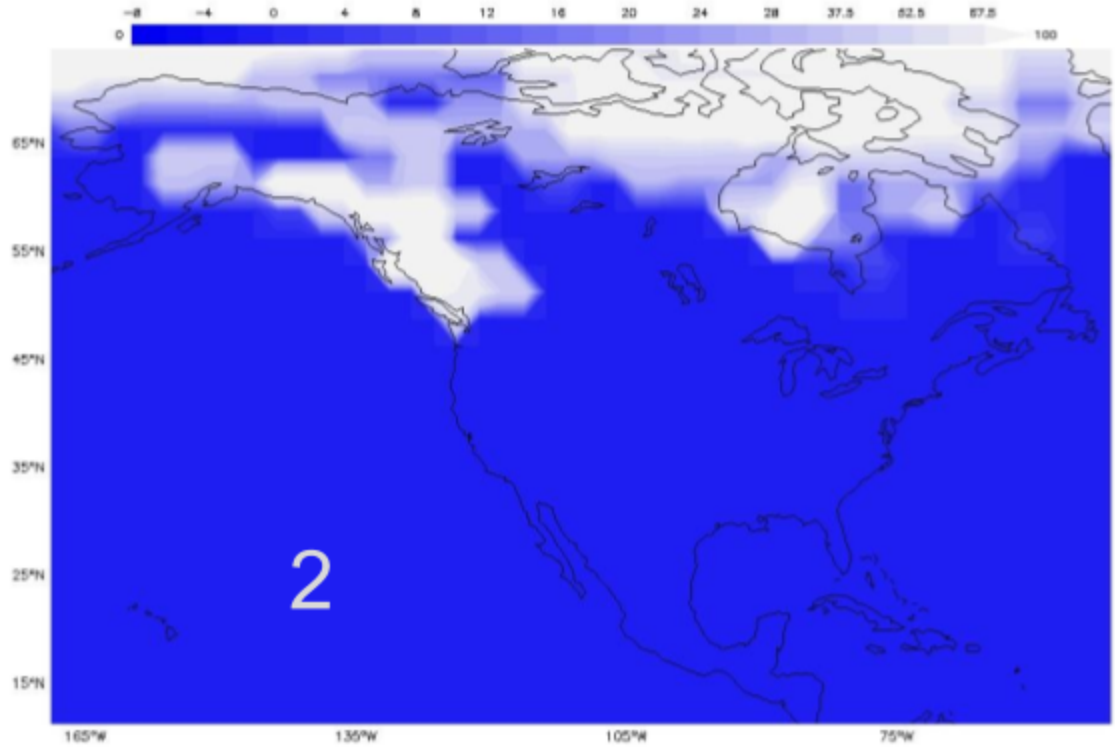
Snow/Ice Amount (percent)



Data Visualization

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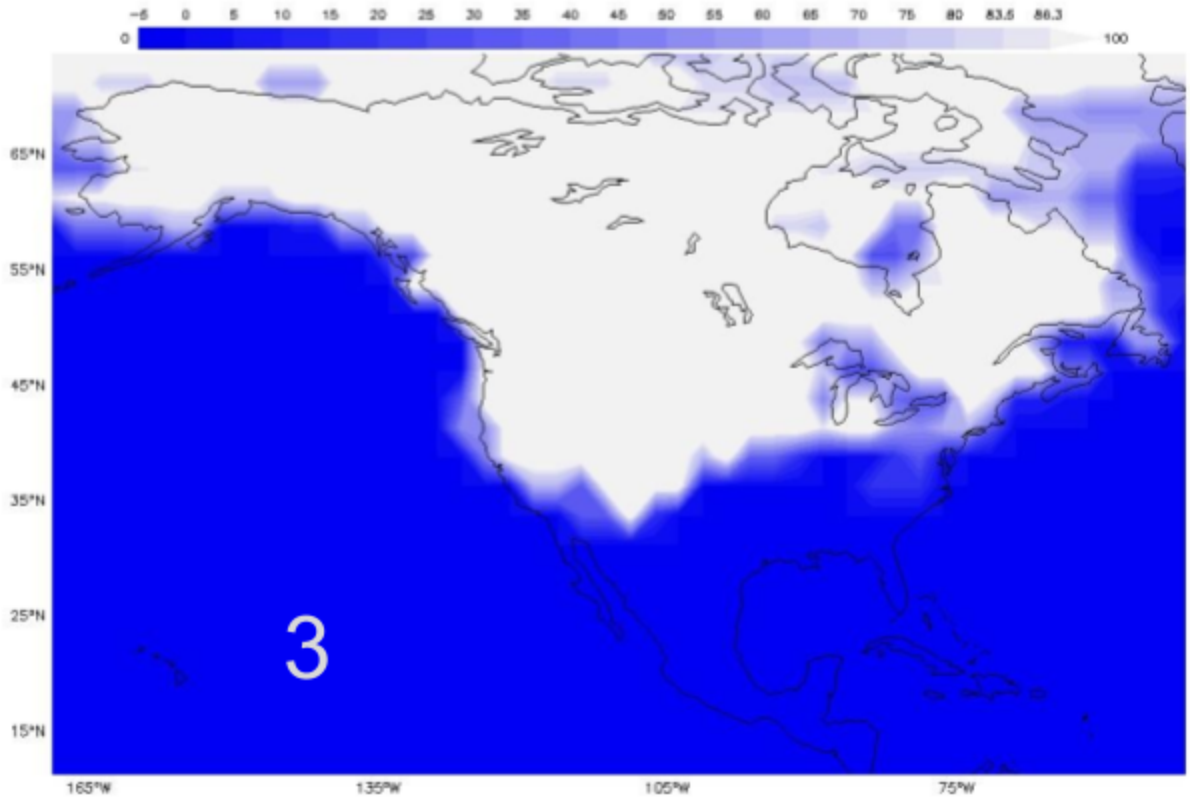
Snow/Ice Amount (percent)



Data Visualization

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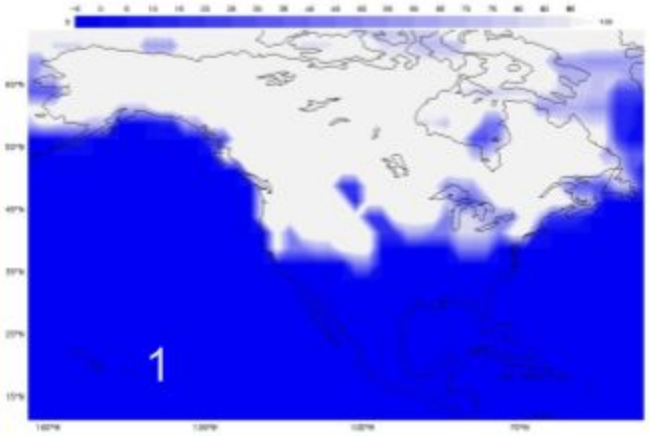
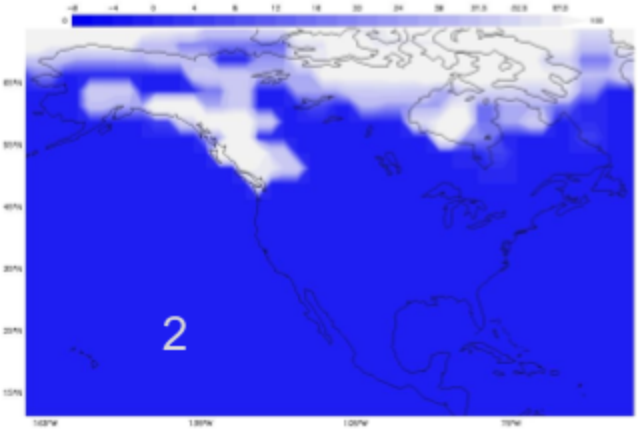
Snow/Ice Amount (percent)

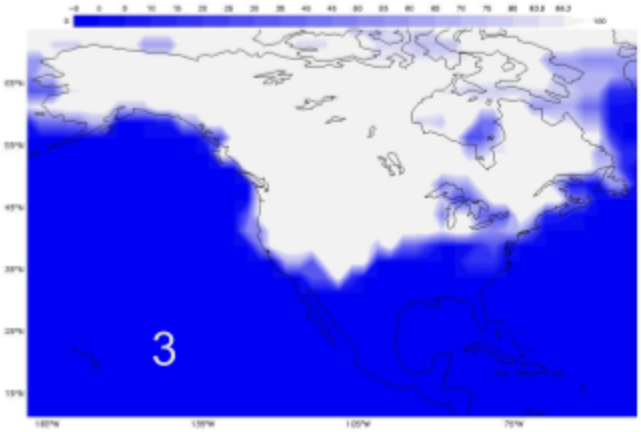
March 2008



June 2008



January 2008



Data Visualization
Monthly Leaf Area Index

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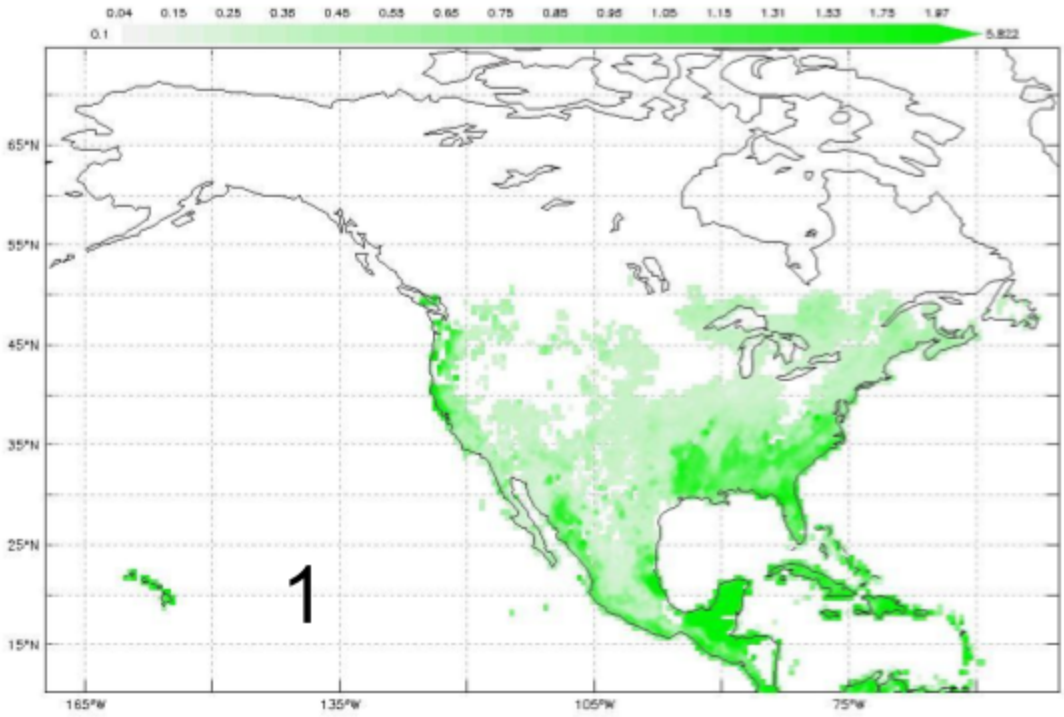

Data Visualization
Monthly Leaf Area Index

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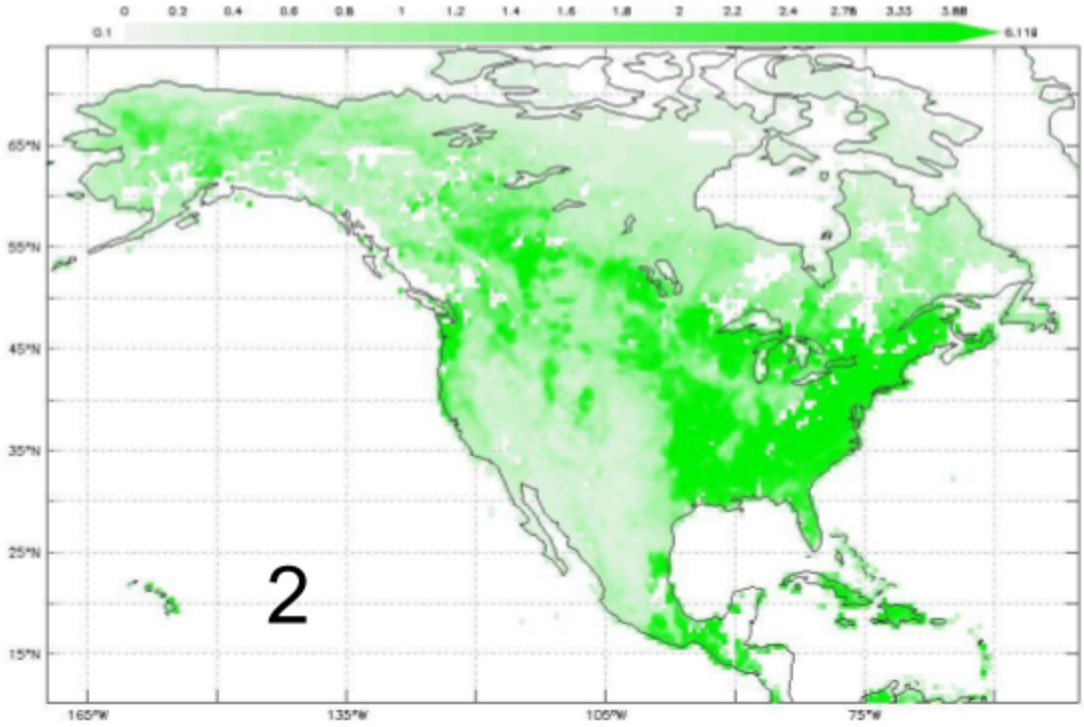

Data Visualization

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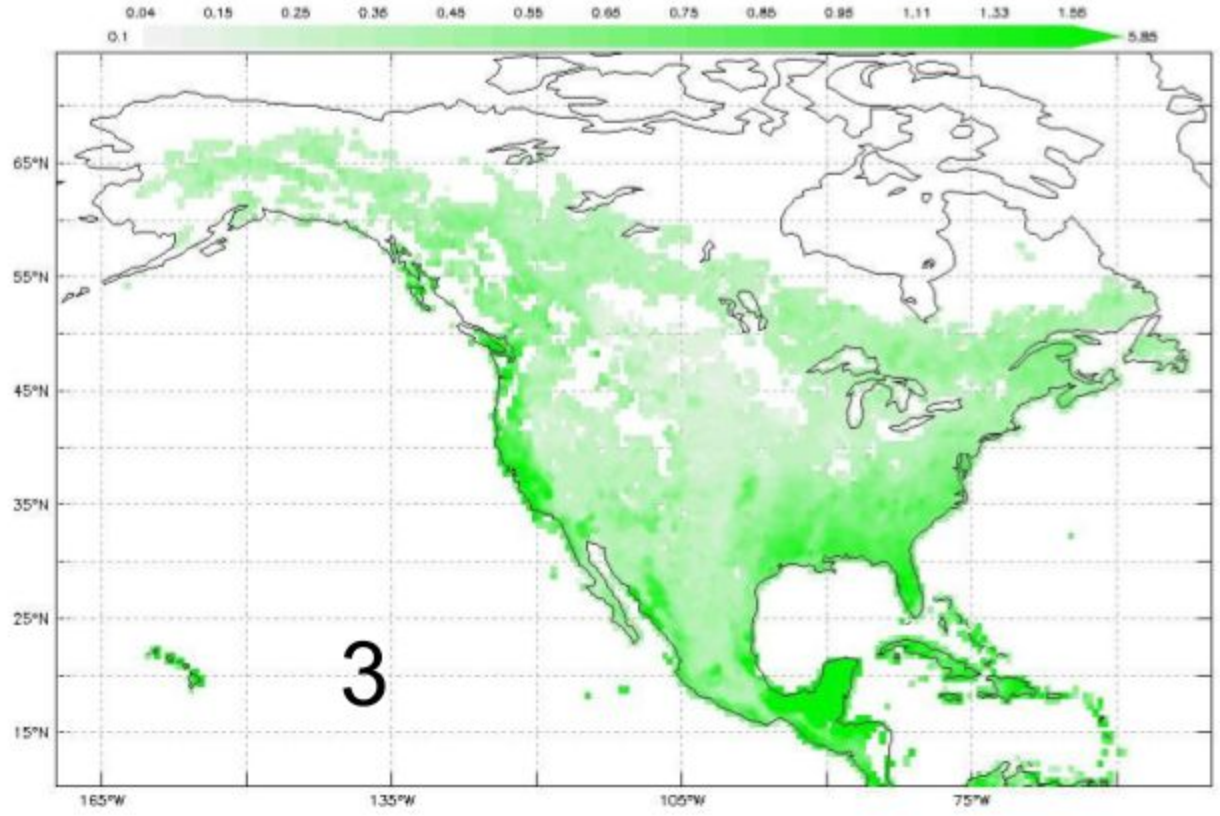
Monthly Leaf Area Index



Data Visualization

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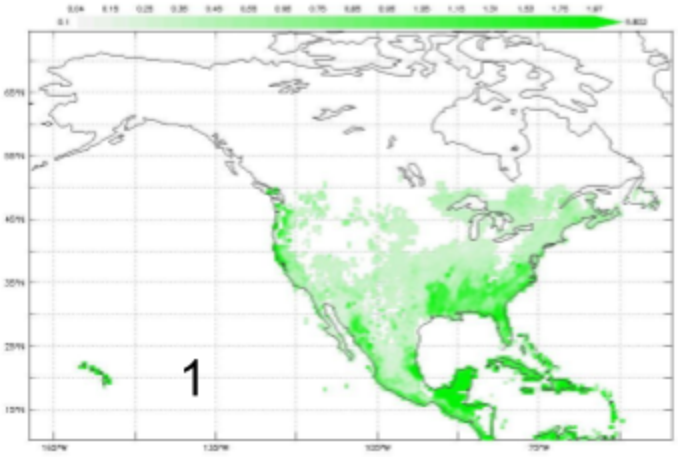
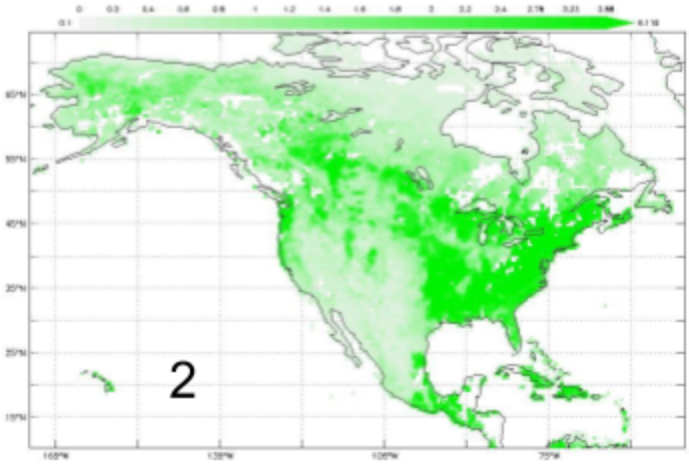
Monthly Leaf Area Index

January 2008



June 2008



March 2008